

## WHAT IS CLAIMED IS:

1. A swirl chamber used in association with a combustion chamber for diesel engines, wherein the combustion chamber is  
5 defined by a piston, a cylinder, and a cylinder head, the swirl chamber comprising:

a mouthpiece fitted in a hole of the cylinder head, the hole having a bottom-open recess, and the mouthpiece including a top-open recess, the bottom-open recess and the top-open recess  
10 constituting a space intended for the swirl chamber;

a main nozzle hole produced through a base wall of the mouthpiece to effect communication between the combustion chamber and the swirl chamber; and

a pair of sub-nozzle holes produced through the base wall of the  
15 mouthpiece, the holes being positioned symmetrically on opposite sides of the central axis of the main nozzle hole;

wherein each of the sub-nozzle holes is arranged to pass inside a hypothetical first circle having a radius of 70% of that of a hypothetical second circle depicted around the center of the  
20 top-open recess.

2. The swirl chamber as recited in claim 1, wherein the first circle has a radius of 60% of that of the second circle.

25 3. The swirl chamber as recited in claim 1, wherein the first

circle has a radius of 50% of that of the second circle.

4. The swirl chamber as recited in claim 3, wherein each of the sub-nozzle holes is positioned such that its respective center  
5 coincides with the first circle having a radius of 50% of that of the second circle.

5. The swirl chamber as recited in claim 1, wherein each of the sub-nozzle holes is positioned such that its central axis passes  
10 within an angular range of  $0^{\circ}$  to  $30^{\circ}$  away from a reference line supposed to pass axially through the sub-nozzle hole.

6. The swirl chamber as recited in claim 5, wherein the angular range is  $0^{\circ}$  to  $15^{\circ}$ .

15

7. The swirl chamber as recited in claim 1, wherein the total area of the open ends of the sub-nozzle holes is in the range of 3% to 15% of that of the main nozzle hole.

20 8. The swirl chamber as recited in claim 7, wherein the total area is in the range of 4% to 10% of that of the main nozzle hole.

9. The swirl chamber as recited in claim 1, wherein the main nozzle hole comprises a main groove and two side grooves each  
25 communicatively continuous to the main groove through banks.

10. The swirl chamber as recited in claim 9, wherein the side grooves are positioned such that their central axes exist rearward of that of the main groove.

5

11. The swirl chamber as recited in claim 10, wherein each of the side grooves has its central axis inclined at a smaller angle than an angle at which the central axis of the main groove is inclined with respect to the level of the base wall of the mouthpiece.

10

12. The swirl chamber as recited in claim 11, wherein the side grooves are positioned such that the distance between them diminishes toward their forward ends.

15

13. The swirl chamber as recited in claim 9, wherein each of the side grooves has a progressively diminishing cross-sectional area toward its forward end.

20

14. The swirl chamber as recited in claim 9, wherein each of the side grooves is positioned such that its central axis is in parallel to, and rearward of, the central axis of the main groove.

25

15. The swirl chamber as recited in claim 1, wherein each of the sub-nozzle holes is positioned such that its central axis extends within an angular range of  $0^{\circ}$  to  $30^{\circ}$  away from a reference line

supposed to pass axially through the sub-nozzle hole.

16. The swirl chamber as recited in claim 15, wherein the total area of the open ends of the sub-nozzle holes is in the range of 3% to 15% of that of the main nozzle hole.

5

17. The swirl chamber as recited in claim 15, wherein the main nozzle hole comprises a main groove and two side grooves each communicatively continuous to the main groove through banks.

10

18. The swirl chamber as recited in claim 17, wherein each of the side grooves is positioned such that its central axis is in parallel to, and rearward of, the central axis of the main nozzle hole.

15

19. The swirl chamber as recited in claim 1, wherein the sub-nozzle holes are positioned such that their central axes are upright on the base wall of the mouthpiece.

20

20. The swirl chamber as recited in claim 19, wherein the total area of the open ends of the sub-nozzle holes is in the range of 3% to 15% of that of the main nozzle hole.

25

21. The swirl chamber as recited in claim 19, wherein the main nozzle hole comprises a main groove and two side grooves each communicatively continuous to the main groove through

banks.

22. The swirl chamber as recited in claim 21, wherein each of the side grooves is positioned such that its central axis is in parallel to, and rearward of, the central axis of the main groove.

5

23. The swirl chamber as recited in claim 9, wherein each of the side grooves is forwardly inclined at an angle of elevation from a main combustion chamber to the swirl chamber.

10

24. The swirl chamber as recited in claim 9, wherein each of the side grooves is rearward inclined at an angle of elevation from a main combustion chamber to the swirl chamber.

25. The swirl chamber as recited in claim 1 wherein the  
15 sub-nozzle holes are positioned such that the distance between them becomes narrower toward their top open ends.

26. The swirl chamber as recited in claim 1, wherein the  
sub-nozzle holes are positioned such that the distance between  
20 them becomes wider toward their top open ends.